Philip James Bull

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Date of Birth: 30th Nov 1987 // Nationality: British

Research positions

Oct 2015 –	**NASA Postdoctoral Program (NPP) Fellow** Jet Propulsion Lab./California Institute of Technology
May 2013 – Oct 2015	**Postdoctoral Fellow, University of Oslo** Institute of Theoretical Astrophysics

Education and qualifications

Oct 2010 – Apr 2013	**DPhil Astrophysics, University of Oxford** Theoretical cosmology, supervised by Pedro Ferreira and Tim Clifton. Thesis title: "Dark Energy and the Inhomogeneous Universe".
2006 – 2010	**MPhys Physics with Astrophysics, University of Manchester** First class honours, top of class. Specialised in astrophysics/theoretical physics.

Awards and scholarships

2012	Pollard Fund travel grant (Wadham College, University of Oxford)
2010	Outstanding Academic Achievement Award (University of Manchester)
2010	Samuel Bright Research Scholarship in Physical Sciences (U. Manchester)
2006 – 2010	President's Award (University of Manchester)
2006 – 2010	Foresters Scholarship
2009	Hatfield-Heginbottom Scholarship (University of Manchester)
2008	Hatfield Scholarship (University of Manchester)
2004	Award for Academic Achievement (Staffordshire University)

Professional activities and collaborations

2015	Parallel session chair, UK National Astronomy Meeting (Llandudno, UK)
2014 – 2015	Local organiser, Beyond ΛCDM international conference, Oslo (Jan 2015)
2013 onwards	Member of the SKA Cosmology Science Working Group (Core Team)
2013 – 2015	Member of the Planck Collaboration (LFI Core team)
2012 onwards	Regular referee for PRL and PRD (occasionally for MNRAS/ApJ/PLOSone)

Teaching experience

2015 onwards	PhD project co-supervisor, Mikael Bull Steen (University of Oslo)
2014 – 2015	Masters project supervisor, Robert Olav Fauli (University of Oslo)
Feb 2014	One-day course on "Successful student supervision", Nordic Net. ECR (Astro)
Dec 2012	Activity leader/designer, IOP Physics update conference (teacher training)
2011 – 2013	Tutor, "Symmetry and Relativity", 3rd year physics (St. Edmund Hall, Oxford)
2011 – 2012	Short-course lecturer, "Python for Astrophysicists", Oxford Astro. Grad. course

Research

My research covers the intersection of theoretical and observational cosmology. I am interested in what inhomogeneities can tell us about dark energy, and how novel observables and statistical tools can be used to make inferences about the cosmos on the largest scales. Research topics include:

- Cosmology with intensity maps of the redshifted neutral hydrogen 21cm line
- Secondary anisotropies and spectral distortions of the CMB as cosmological probes
- Bayesian inference, stochastic processes, and computational physics
- Long-range peculiar velocity surveys and tests of gravity using the kinetic SZ effect
- The general-relativistic effects of matter inhomogeneities on light propagation

Journal articles (published/submitted)

1. Extending cosmological tests of General Relativity with the Square Kilometre Array
   P. Bull, ApJ (submitted) [1509.07562]
2. Weighing neutrinos with cosmic neutral hydrogen
   F. Villaescusa-Navarro, **P. Bull**, M. Viel, ApJ (accepted) [1507.05102]
3. A systematic study of Ly-α transfer through outflowing shells: Model parameter estimation
   M. Gronke, **P. Bull**, M. Dijkstra, ApJ 812, 123 (2015)
4. Observational signatures of modified gravity on ultra-large scales
   T. Baker, **P. Bull**, ApJ 811, 2 (2015)
5. Ultra-large scale cosmology with next-generation experiments
   D. Alonso, **P. Bull**, P. G. Ferreira, R. Maartens, M. G. Santos, ApJ (accepted) [1505.07596]
6. Cosmological performance of SKA HI galaxy surveys
   S. Yahya, **P. Bull**, M. G. Santos, M. Silva et al., MNRAS 450, 2251 (2015)
7. Cross-correlating 21cm intensity maps with LBGs in the post-reionization era
   F. Villaescusa-Navarro, …, **P. Bull** et al., JCAP 03, 034 (2015)
8. A CMB Gibbs sampler for localized secondary anisotropies
   P. Bull, I. K. Wehus, H. K. Eriksen, P. G. Ferreira et al., ApJS 219, 10 (2015)
9. Blind foreground subtraction for intensity mapping experiments
   D. Alonso, **P. Bull**, P. G. Ferreira, M. G. Santos, MNRAS 447, 400 (2015)
10. Late-time cosmology with 21cm intensity mapping experiments
    P. Bull, P. G. Ferreira, P. Patel, M. G. Santos, ApJ 803, 21 (2015)
11. Quintessence in a quandary: On prior dependence in dark energy models
    D. J. E. Marsh, **P. Bull**, P. G. Ferreira, A. Pontzen, Phys. Rev. D 90, 105023 (2014)
12. A multi-level solver for Gaussian constrained CMB realizations
    D. S. Seljebotn, …, **P. Bull**, ApJS 210, 24 (2014)
13. What if Planck's Universe isn't flat?
    P. Bull, M. Kamionkowski, Phys. Rev. D 87, 081301(R) (2013)
14. Local and nonlocal measures of acceleration in cosmology
    P. Bull, T. Clifton, Phys. Rev. D 85, 103512 (2012)
15. The isotropic blackbody CMB as evidence for a homogeneous universe
    T. Clifton, C. Clarkson, **P. Bull**, Phys. Rev. Lett. 109, 051303 (2012)
16. The KSZ effect as a test of general radial inhomogeneity in LTB cosmology
    P. Bull, T. Clifton & P. G. Ferreira, Phys. Rev. D 85, 024002 (2012)

Conference proceedings

- Measuring baryon acoustic oscillations with the SKA
  P. Bull et al., PoS (AASKA14) 024
- Cosmology from galaxy surveys with the SKA
  F. B. Abdalla et al., PoS (AASKA14) 017
- Cosmology from a HI intensity mapping survey with SKA Phase 1
  M. G. Santos et al., PoS (AASKA14) 019
- HI Simulations of Galaxy Number Counts and Bias
  M. G. Santos et al., PoS (AASKA14) 021
- Cosmology on the largest scales
  S. Camera et al., PoS (AASKA14) 025
- Measuring redshift-space distortion with the SKA
  A. Raccanelli et al., PoS (AASKA14) 031
- Foreground Subtraction in Intensity Mapping
  L. Wolz et al., PoS (AASKA14) 035
- LSST synergy with the Square Kilometre Array
  D. Bacon et al., PoS (AASKA14) 145
- Euclid – SKA Synergies
  T. Kitching et al., PoS (AASKA14) 146
- 21cm Cosmology
  M. G. Santos, D. Alonso, **P. Bull** et al., Proc. IAU 306, CUP (2015)

Research visits *(2 weeks or longer)*

2015	Perimeter Institute (Canada)
2014	Perimeter Institute (Canada); Oxford Astrophysics (UK); JPL/Caltech (USA)
2013	JPL/Caltech (USA); Oxford Astrophysics (UK)
2012	Dalhousie University (Canada)
2011	University of Cape Town (S. Africa)

Public outreach and media

Apr 2015	Interviewed in series of five articles on the SKA in Norwegian (forskning.no)
Jan 2015	Quoted in articles on BICEP2 (Smithsonian), SKA (CBS, Astronomy Now)
Nov 2013	Interview: The Register (news website)
Jan 2013	Public lecture: “Brief History of the Universe”, BBC Stargazing Live Newbury
Jan 2013	Invited talk: Wadham College graduate research forum
2012 – 2013	STEM Ambassador (STEMNET/University of Oxford)
2012 and 2013	Co-organiser: Stargazing Oxford space science festival
2012	Interviews: PBS Nova Physics Blog; JodCast (astronomy podcast)
2011 – 2012	Public outreach coordinator for Astrophysics (University of Oxford)

Talks and seminars

2015	Invited colloquium: Oskar Klein Centre (Sweden)
	Departmental/group seminars (5): Caltech, JPL, Fermilab (USA); Heidelberg (Germany); Queen Mary (UK)
	Contributed talks (2): Building an Open UK SKA-Science Consortium (RAS, UK); Nordic Physics Days (Trondheim, Norway); NAM 2015 (RAS, UK)
2014	Invited talk: Radio intensity mapping as a new cosmological tool (RAS, UK)
	Invited colloquia (2): Oxford (UK); Oslo (Norway)
	Contributed talks (2): Advancing Astrophysics with the SKA (Sicily, Italy); Dark Energy Interactions (Stockholm, Sweden)
	Departmental/group seminars (6): Oslo (Norway); 2 x Perimeter Institute, U. British Columbia (Canada); INAF/OATS Trieste (Italy); LBNL Berkeley (USA)
2013	Contributed talk: Synergistic science with Euclid and the SKA (Oxford, UK)
	Departmental/group seminars (2): Johns Hopkins (USA); Manchester (UK)
2012	Contributed talk: National Astronomy Meeting 2012, Manchester (UK)
	Departmental/group seminars (10): Helsinki (Finland); Lyon (France); Heidelberg, Bielefeld (Germany); Oslo (Norway); Geneva (Switzerland); Queen Mary (UK); Pittsburgh, Stanford, Berkeley/LBL (USA)
2011	Contributed talk: Inhomogeneous Cosmologies Workshop, Jyväskylä (Finland)
	Departmental/group seminars (2): Dalhousie (Canada); Cape Town (S. Africa)

Public scientific code

I make much of my scientific computer code publicly-available for the sake of transparency and reproducibility, and to enable others to re-use and build on my work. Recent projects include:

- **Commander 2 (Python/C/Fortran)**
  Full-sky CMB component separation code, based on Gibbs sampling. Implements high-performance multi-level linear solver for constrained realisations of the CMB. Designed for high-performance analysis of full-resolution multi-frequency Planck data.
- **FIST (Python)**
  CMB Gibbs-sampling code tailored for localised signals (e.g. SZ clusters), working in the flat-sky limit. Built for rapid, statistically-consistent analysis of high-resolution data from small-angle CMB experiments such as ACT and SPT.
- **RadioFisher (Python)**
  General, fully-featured Fisher-forecasting code for 21cm intensity mapping experiments.
- **Spectral Distortions (Python)**
  Code for integrating the general linear perturbation equations for redshifts and luminosity distances. Used to calculate spectral distortions of the CMB from late-time inhomogeneities.
- **Bubble (C++/Python)**
  Relativistic background solver and ray-tracing code for spherically-symmetric inhomogeneous spacetimes.

See www.philbull.com/code.html for more.

Technical computing skills

- Experienced Python, C/C++, and Fortran 90 programmer, including MPI applications.
- Expert in plotting/visualisation with Matplotlib (Python).
- Experienced user of a number of scientific software packages, including SciPy, Commander, CosmoMC, CAMB, and HEALPIX. Experience with Mathematica, GRTensorII, and ROOT.

Open source projects

I have been involved in the open source software movement for the past decade. This has exposed me to a variety of interesting ideas and experiences that I often find useful in my scientific work, and has given me valuable experience in working across disciplinary boundaries.

- **GNOME Documentation Project**
  Contributor/member of steering committee. Responsible for designing, writing, and editing end user and developer documentation. Designed terminology and style guidelines. Coordinated major rewrite in Mallard XML with the introduction of GNOME 3.
- **Books on Ubuntu Linux**
  Co-author of two (related) books on Ubuntu Linux: *Ubuntu for Non Geeks 4th Ed.* (ISBN 978-1593272579) and *Ubuntu Made Easy* (ISBN 978-1593274252), both with Rickford Grant, and published by No Starch Press, San Francisco.
- **GNOME Outreach Programme for Women**
  Mentor for two rounds of the outreach programme. Responsible for designing and coordinating documentation projects, and training and pastoral care of students.